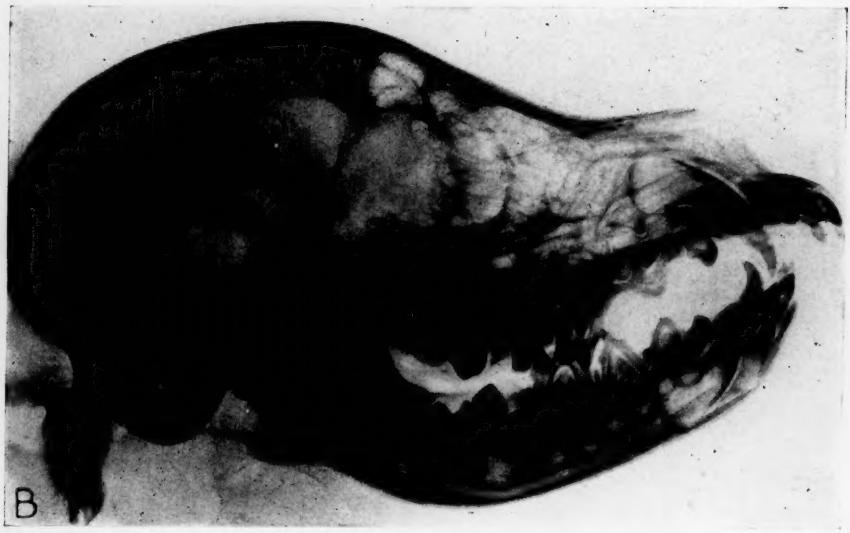
The Journal of HEREDITY



DEFECTIVE "PIG-JAW"
(SEE PAGE 177)

A Human Mosaic

Lethal Dwarf in the Fowl

Timing Pollen Production in Grapes

Two "Green-Shoulder" Genes in the Tomato

Color of Hybrid Landrace-Poland China Pigs

VOLUME 36 JUNE, 1945 NUMBER 6

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HALF-AND-HALF

Figure 1

Sharply divided down the midline, the left half of this woman's body is one huge "birth-mark." The left side perspires much more freely than the right. The pupil of the right eye is grey; that of the left eye, dark brown. Such bilateral differences have been reported in birds, guinea pigs and mice, but have never before been described in detail in a human being. See note on page 192.

A HUMAN MOSAIC

Bilaterally Asymmetrical Noevus Pigmentosus Pilosus et Mollusciformis Unilateralis

M. ZLOTNIKOFF

*Medical Institute, Ivanovo**

EDITOR'S NOTE: *This remarkable contribution came to hand some months before the war virtually suspended communications with the Soviet Union. Some suggestions for modifying the discussion of possible causes of the mosaic were addressed to the author and the manuscript was "put on ice" to await his reply. In the press of other matters it remained there much longer than originally intended. It may still be many months before we will hear from the author, so we are proceeding with the publication of the article essentially as submitted.*

THE author has not been able to find a case of mosaic mutation in man in the available literature, and therefore, he considers the present case to be worthy of publication. A careful study of the geneology of this case showed that we may possibly be dealing with a case of newly formed mosaic mutation.

Its clinical aspect is shown by the following history of the disease of the proband:

E. P., an assistant veterinarian, female, 24 years old, came to the surgical department of the 1st Medical Institute with a request to perform an operation on account of a pigmented patch on the left side of her face and neck. The patch covers the whole neck and the left cheek, beginning at the forehead and going exactly down the midline of the body, from the forehead to the groin. The entire left leg is pigmented as though covered by a stocking.

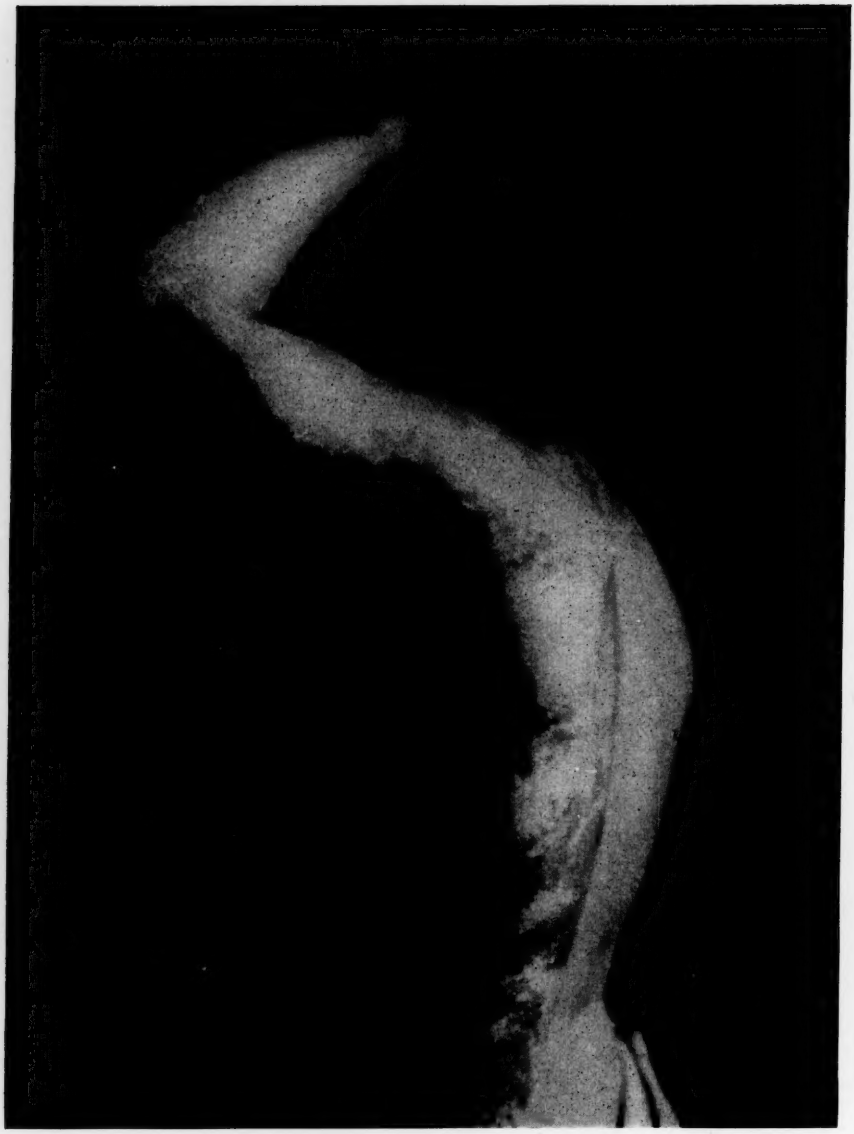
The patient is also bald on the left side of her head (strictly on the median line following the suture of bones of the sinciput). The affected left side of her body perspires more abundantly than the right. The sweat stains are of a dark-brown color and are removed with difficulty from the linen. Perspiration on the right side is normal and colorless. The patient is excitable, often cries for a long time (some hours running), sleeps badly, has a bad memory, concentrates poorly. Considers that she has been ill since childhood (i.e., the patches have existed).

The patient was born in the country, in the Tambov district, in a well-to-do peasant family. Her childhood was spent in the country. She began to work early having lost her mother when she was four years old. At 14 she graduated from the country school, and this ended her education. She worked chiefly at home. When 20 years old she, acting on the advice of her friends, went to Moscow in order to undergo treatment. She visited several dispensaries in the town and spent half a year in a hospital. Then she returned home. Having spent three years in the country, she came back to Moscow, firmly determined to be cured at all costs. The patches on her face, neck and body have greatly troubled her since childhood, when she was mocked at as a "devil." During adolescence, friends avoided her, being afraid of "infection." When she grew up she preferred to be alone: "less mockery, fewer tears." Thus the patient formulated her desire for solitude. As she grew up the patient became morose and sullen.

Heredity

In order to find out the genotypic factors of interest I undertook an excursion to the home-country of the patient, where the majority of her rela-

*From the 1st surgical dept. 1st Medical Institute, Moscow; Director, Prof. Dr. N. N. Burdenko.



BACK AFFECTED TO MIDLINE

Figure 2

The nevus-like skin extends exactly to the center of the spine. The left leg is completely covered with pigmented skin as though by a stocking.

tives lived. I examined 44 out of 53 members of her family, in three generations. With regard to distant relatives I had to employ the usual methods of genealogic investigation, that is, the study and collection of data concerning these persons on both the ascending and side lines. I not only took into consideration the phenotypic likeness (exterior) but tried by every means to discover features of interest among other families in the population. For that I visited the 23 neighbouring villages among which there were the greatest possibility of intermarriage. The most valuable information I obtained was from one of the brothers of the patient who was a servant in a public bath on a collective farm. When he learned of my interest in his sister's affliction, he was able to tell me positively that during the two years of his work he had seen nothing like it. His wife, who worked in the women's department of the same public bath, said the same. My own investigations as well as talks with the neighbours proved the absence of this "feature" not only in the family of our patient but in any other families of the same village who in any way came under my observation. Matings between relatives were categorically denied. The whole family of the patient, her grandfather on her father's side, her father, brothers, sisters, uncles and aunts are remarkably healthy, big, well-developed people. Compared to them, our patient seems to be a poor undeveloped specimen, in spite of being well fed as a child. The patient's father is an exceptionally healthy man. The mother died of typhoid fever at the age of 35. Tuberculosis and lues were denied. I was not able to find any other pathological phenomena amongst them except one cousin who became blind after variola. The mother had 10 pregnancies, two died at the age of four years after dysentery, two abortions, six alive, our patient is the seventh.

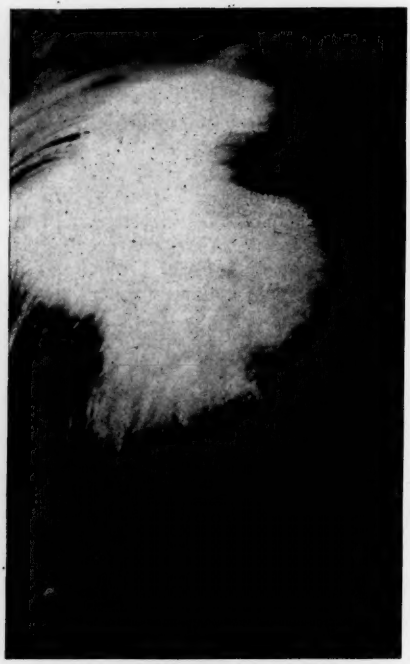
The patient herself was born at term, the seventh child, the father being 35 and the mother 27 years old. She was breast-fed till the age of one year, after that additional artificial feeding. Teeth appeared late. She began to walk at eighteen months. Some mental retardation until an age of four years was reported, then quick development. She began to talk rather late. Of childhood diseases she had measles (six years), scarlet fever (eight years) and some kind of "fever" (nine years) during which she did not recognize anyone, ran in the fields, and destroyed everything aimlessly. At 19 suffered from typhoid fever, at 21 from malaria (six months).

History of the Present Disease

The patient was born with a pigmented patch on the left side of the neck, face, body and extremities. During the first days of life the patch was pinkish, sharply limited by the median line of the face and body, as it exists at present. Little hair on the head. When the patient was two to three years old, the parents noticed that her hair was not uniform, being lighter and poorer on the left side. By the time she was six, a definite border of incipient baldness appeared on the left side, strictly following the suture of the bones of the crown of the head. With age the baldness increased down to the neck and across to the forehead. By 12-14 years the baldness appeared to have become stabilized at about the area now affected.

The patient informed us that since early childhood, she, though not physically weak, was covered with perspiration whenever she made the slightest exertion. The left part of her body perspired more abundantly, leaving dark brown stains on her clothes, while the right was only moist and did not leave any stains on the linen. This is the condition at present.

Status praeseus. The patient is below average height — 158 cm., weight 52.5 kg., of normal physical development. Lymphatic glands are not palpable; the mucosae are pale; the skin of the face and body is unevenly colored, and of uneven appearance. The right half of the body is entirely normal with respect to skin color and structure, both



BALD AREA ON LEFT SIDE

Figure 3

Hair is lacking to the left of the midline, though part of the left side of the skull is unaffected. There is also a bald area above and back of the ear.

on the back and front of the body. The same limits (strict asymmetry) are seen on the back, following the spine and the buttock folds. The abnormal skin characterizing the left side of the body does not extend beyond the mid-line at any point. Following the median line, the left half of the face is covered by a slightly elevated swelling of dark brown color. In the region of the collarbone this granular skin on the upper breast is a "café au lait" color. The pigmented regions form stripes like military "shoulder-knots" from the shoulder to the spine. The whole upper shoulder region, both front and back, is covered by an elevated swelling of dark brown color. There is no hair in the left arm-pit, and abundant hair in the right one. In the region of the breast, the swelling is of a more intensive dark color. The nipple is larger than the right, horn-like, heavily pigmented and compact on palpation. The upper abdomen is covered with a granular swelling of soft consistency, dark-red in color, slightly elevated on palpation. The coloration of the skin in this region as well as the left subcostal and lumbar regions reminds one of an oil-painting, where the paint has been applied in heavy "dabs." These have a semi-circular appearance, the rounded part directed upwards. Between the navel and the left subcostal region there is a patch of less affected skin which is still considerably darker than the normal skin on the right. The left leg is of a dark brown color as if it were covered by a dark stocking. The skin on the knee and foot is dark brown, granular, and horn-like. On the back, as we have already mentioned, the same border is followed, a strict asymmetry on the spine and the buttock fold (Figure 2). The skin on the left side is partly of intense dark brown color, partly crimson, and partly "café au lait."

The physical condition of the patient revealed nothing abnormal other than the conditions reported here. Neurologically the patient was active, with no passive movements or contractions. An absence of paresi. No pathological reflexes. The tendon reflexes are higher on the left side. Reactions to heat, pain and skin sensibility normal on both sides. There was a constant itching on the left side of the body; as a result of this the patient is covered with scratches. The left side of the body perspires more abundantly than the right.

Result of Pilocarpin Injection

In order to test differences in reaction of the two sides, one cc. of pilocarpin hydrochloride (10%) was injected subcutaneously. Blood pressure S/D = 3 mm. before the injection; 5 minutes after the injection S/D = 25 mm.; after 15 minutes S/D = 19 mm.; after 25 the difference was 5 mm., after 50

minutes 3 mm. and so till the end of the test.

Fifteen minutes after the injection there was a feeling of heat. A slight flushing of the face appeared at the tenth minute, reached approximately a maximum ten minutes later, continued for a half hour, and then began to decrease. After twenty minutes, there appeared a coloration in the region of the thyroids. A weak secretion of saliva appeared after 15 minutes, sharply increased at the 20th and then somewhat decreased.

Five minutes after the injection small drops of sweat appeared on the left eyebrow, on the left side of the tip of the nose, on the left half of the upper lip and on the chin. The right side of the face remained quite dry. After 10 minutes big drops appeared on the left side of the lip, left half of the chin, left cheek, in the left axilla, on the left side of the back and in the left groin. The right side of the body was hardly noticeably moist, more clearly seen in the right axilla. After 15 minutes the whole face was covered with big drops of sweat, with intense perspiration on the left side on the neck, breast and back. On the left side of the face the sweat flowed in streams, with a more intense perspiration on the left side of the abdomen and back as far as the median line. After 25 minutes the perspiration considerably increased, especially on the left side of face and body. After 45 minutes sweat flowed in a continuous stream on the left cheek, whereas on the right one it formed only big drops. After 60 minutes the perspiration began to decrease, at first on the right side of the face and body. Before the investigation a slight red dermographism could be observed on the left side of the breast, a hardly noticeable pink one on the right side. After 10 minutes red dermographism on the left breast, a weak pink one on the right. After 15 minutes a bright red one on the left breast, no change on the right. The above mentioned phenomena remained during the whole experiment. It is interesting to note that 25 minutes after the injection of pilocarpin the patient stated that her condition and the visible phenomena were in general familiar to her and were only a more intense reaction of the peculiarities (vegetation) of her organism.

Blood pressure was almost similar in both upper extremities before the injection of adrenaline (.5 cc. — 1:1000). The difference S/D = 3 mm. 5 minutes after the injection; S/D = 12 mm.; after 25 minutes = 8 mm.; after 35 minutes S = D; after 45 minutes S/D = 10 mm.; by the end of the experiment (60 minutes), S/D = 5 mm.

Atropin (1 cm. 3 — 1:1000) gave approximately the same effect. The investigation of the vegetative nervous system was undertaken with the same results.

Luttge Mertz reaction. Front hypophisis, back, trace of thyroid and parathyroid, suprarenal gland, ovaries.

Wasserman. Twice negative. *Nonne Appel Reaction*—weak positive.

Blood. Hb 62%, P.—8% = 60 H, S—52% = 60 H, U—3%, E—2%, M—8%. Lymeph—27%.

Psychical state. Clear conscience. Bad memory, acquires with difficulty. Often cries. Likes solitude. Psychopathic. Neurologica phenomena—reaction to basic illness.

Vision. A peculiarity of the papillae of the visual nerves noticeable at the bottom of the eye. In both eyes the papillae of the visual nerves have a *shaded design*, a nimbus around the border. The location of the vessels is somewhat irregular especially on the right a "Sohein-neuritis" picture as the result of an incorrect formation of the papillae of the visual nerve V.O. D = 0.4, V. O.S. = 1.0. The right pupil is grey, the left dark brown.

X-ray photography gave no indication of pathological deformation.

Origin of the Condition

If we assume that at the stage of two blastomeres a somatic mutation had taken place, i.e., one of these blastomeres underwent some mutation, then the development of these blastomeres would proceed in accordance with that mutation, i.e., the difference between

the "normal" and the mutated blastomere would exist in all stages of development of the organism. If we assume that in our case one of the blastomeres (at the two-blastomere stage) namely, the left underwent a mutation then we can easily understand from what has already been said that the left side of the organism would reflect all the features resulting from the mutation, that took place at the stage of the blastomeres, and the pathology of the organism would be strictly asymmetrical (one-sided, the left side in the present case). Assuming that this explanation is the most probable one, we are inclined to apply it in the present case, as it is impossible to give any other explanation to this one-sided asymmetry of mosaic mutation in our patient, the bald area following the sutures of the bones at the crown of the head (median line) the difference in quality and hair coloration of the head, scarce light red on the right and abundant chestnut on the left. Beginning from the forehead along the median line strictly asymmetrical, and ending with the left leg, the left half of the body is covered by a somewhat swollen pigmented patch of different colors (dark brown, scarlet and "café au lait"); the difference in the coloration of the pupil, the left being dark brown, and the right, grey; different degree of perspiration, colored and abundant on the left and poor and colorless on the right; the difference in reflexes and blood-pressure R/R = S/D, higher on left.

The patient considers herself if not a blastomatous variation then a new species obtained as a result of a somatic mutation at the stage of two blastomeres.

Let us point out the geneography of this mutation, the patient was born in 1907 in the village—Nizne-Spasskoe, ten kilometers from the station Rasskasovo of the Tambov district. She is still living there at present with her parents. All her relatives are living in the same district, in two neighboring villages.

The patient was demonstrated at the Genetic Conference at the Institute of Medical Biology (director prof. Levit) in 1931 in Moscow.

Twins in the Army Medical Corps

The military careers of Col. Ziba L. Henry and Lieut. Col. William H. Henry, twins in the Army Medical Corps, both of whom graduated from the Starling Medical College, Columbus, in 1903, illustrate the extent to which identical twins resemble each other.

Col. Ziba L. Henry was ordered to active duty in the Medical Reserve Corps in 1908 and continued on active duty until World War I started, when he was rapidly promoted to captain, major and lieutenant colonel. He was retired for age in 1936 as a lieutenant colonel but again assigned to active duty in 1941 and later promoted to colonel and was retired because of disability in 1943.

Lieut. Col. William H. Henry entered the Medical Corps as a first lieutenant early in 1917 just after the declaration of war. He was promoted to captain and major and served for four years as a major, with one year's service in England, France and Russia. He was discharged in December 1922 and appointed as major in the Reserve Corps and still later to lieutenant colonel, which rank he still holds.

Both were commissioned as majors in the Medical Corps of the Regular Army in 1920. Both served tours of duty in the Philippines. They graduated from literary and medical school at the same time and both did general practice for a number of years. They are identical twins and few except their intimate friends can tell them apart.—*J.A.M.A.*, May 12, 1945.

A SECOND GENE FOR UNIFORM UNRIPE FRUIT COLOR IN THE TOMATO

G. W. Bohn and D. H. Scott*

THE intensity of the dark green shoulder color of tomato fruits varies considerably in different varieties. Apparently there are several genetic factors which modify this intensity. The character also is modified by environmental factors, especially light; in forcing culture, some growers whitewash glasshouses to reduce the intensity of green color on the stem ends of the tomato fruits, thereby promoting even ripening.

Uniform green color of unripe tomato fruits,† as contrasted with darker green stem-end color, was first described by MacArthur[3] who attributed it to the recessive genetic factor *u/u* on chromosome 7 of the tomato.[4,5] The economic value of uniform color in promoting even ripening of fruits was discussed by Yeager[10] and is further indicated by the practice of shading in the forcing culture of tomatoes mentioned above. Because of this apparent desirability, uniform color has been included in many of the breeding lines developed at the Cheyenne Horticultural Field Station.

Sources of Genes for Uniform Color

Genes for uniform color in breeding lines of tomatoes at the Cheyenne Station have been obtained from two different sources. The genes for uniform color in extremely early, determinate lines developed by Powers[2,6,7,8,9] were obtained from the Danmark variety. This was developed and introduced by the J. E. Olsens Enke Seed Co., of Copenhagen, Denmark. It was found to have value as an early maturing, home garden variety for the central Great Plains region.[1] Uniform color in the Danmark, and in lines derived from it, is governed genetically by the genes *U/u* described by MacArthur[3,4,5] and Yeager,[10] as shown by crosses with Bounty and Victor.

The genes for uniform color in midseason, indeterminate, pink forcing lines developed by Bohn were obtained from a forcing strain of Globe selected by R. W. Braun and D. R. Braun, Denver, Colorado. This strain is referred to in this report as Uniform Globe. Crosses between Uniform Globe and "green-shouldered" varieties yield F_1 hybrids with green-shouldered fruits. One hundred sixty-four plants in progenies from backcrosses of heterozygous individuals to Uniform Globe segregated 84 plants with green-shouldered fruits and 80 with uniform colored fruits (χ^2 for 1:1 calculated ratio = 0.097). These data demonstrate that the inheritance of uniform color and dark green shoulder in progenies from crosses between Uniform Globe and "normal" green-shouldered varieties is governed genetically by a single pair of alleles, with uniform color recessive.

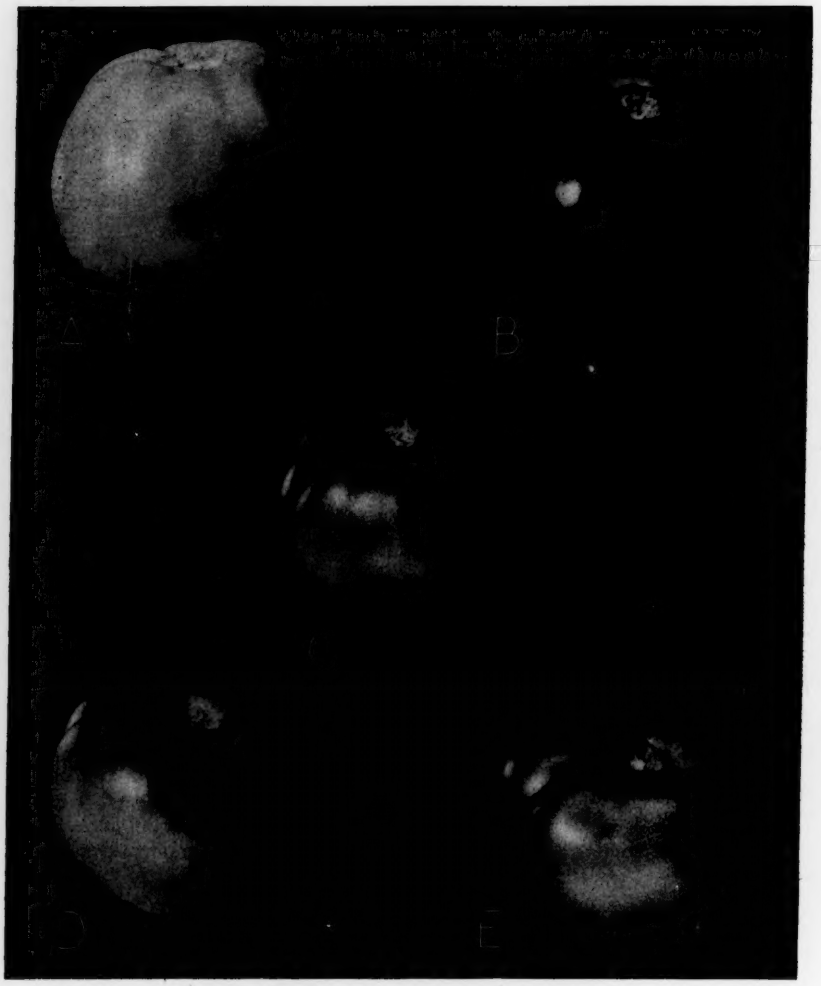
In each of the two groups of lines mentioned above, uniform color is dependent on the action of a recessive gene. Phenotypically, uniform color of Uniform Globe is like uniform color in Danmark, Bounty, and Victor, and a test was made to determine whether the same gene is involved in both groups.

Anomalous Behavior of Unripe Fruit Color in F_1 Hybrids

Crosses were made between extremely early, determinate lines bearing small, yellow-skinned, uniform-colored fruits and midseason, indeterminate lines bearing large, colorless-skinned, uniform-colored fruits. Sixty-eight F_1 hybrids from these crosses grown in the field in

*Associate Pathologist and Associate Geneticist, respectively, Cheyenne Horticultural Field Station, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture.

†Hereafter referred to as "uniform color."



INHERITANCE OF GREEN SHOULDER

Figure 4

Unripe tomato fruits from plants forced in the greenhouse at Cheyenne, Wyoming; photographed August 15, 1944. *A*—Uniform-colored fruit from Uniform Globe. *B*, *C*, *D*—Green-shouldered fruits from F_1 hybrids; *B*—Uniform Globe × Bay State, the latter a green-shouldered variety; *C*—Uniform Globe × Early line 462-3, both parents uniform-colored; *D*—Early line 462-3 × Oxheart, the latter a green-shouldered variety. *E*—Uniform-colored fruit from early line 462-3.

1943 were indeterminate and had yellow fruit skins as expected. However, the young fruits were not uniform in color; they had green shoulders typical of young fruits on plants with the dominant allel of the gene *u* for uniform color. Thirty-six additional F_1 plants grown in the greenhouse also bore fruits with green shoulders (Figure 4). There was no apparent difference between fruits on F_1 hybrids from crosses of (1) early, uniform-colored lines with green-shouldered lines, (2) midseason, uniform-colored lines with green-shouldered lines, and (3) early, uniform-colored lines with midseason uniform-colored lines. Consequently uniform color in the two groups of lines must result from the action of two different and distinct (non-allelic) genes.

Two small F_2 progenies from crosses between lines with uniform color derived from the Uniform Globe were grown in the field in 1944. The plants were classified for uniform color versus green shoulder independently by two observers. A few plants on which the two classifications were not in agreement were placed in their proper classes after careful re-examination. The results (Table I) agree with those expected if uniform color and green shoulder are dependent upon either of two pairs of alleles borne on different chromosomes, uniform color resulting when either locus is homozygous for the recessive uniform color allele. Individuals homozygous for both recessive alleles could not be distinguished from those homozygous for one recessive. It is suggested that the two genes be referred to hereafter as U_1/u_1 and U_2/u_2; U_1/u_1 to indicate the locus on chromosome 7 described by MacArthur,[3,4,5] and U_2/u_2 to indicate the new locus reported here.

Description of Uniform Globe

The selected strain of Globe, referred to here as Uniform Globe, is considered worthy of description because it has better quality than any other variety with uniform color that has come to the authors' attention. It differs from most commercial stocks of Globe in several characters, and is fairly homozygous, having been maintained in forcing culture for several years by D. R. Braun and R. W. Braun of Denver, Colorado.

Forced in Cheyenne, the plant is normal in growth habit (indeterminate and not dwarfed). The plant is relatively slow growing if compared with standard forcing varieties, but increases in height more rapidly than Globe. The stem is moderately thick and succulent, with long internodes. The leaves are large, long and broad, with large leaflets. Clusters of approximately six flowers are borne at intervals of 12 inches (three nodes) on the stem. The flower has a slender, short style which usually does not extend to the tips of the anthers. The anthers are small and frequently produce only small quantities of pollen. The filaments are longer than those of most tomato varieties. Like Globe, Uniform Globe produces low to moderate yields under forcing conditions in the Rocky Mountain and Central Great Plains regions. Unripe fruits have a uniform, pale green color. The ripe fruits are large (four to six oz.) and "globular" (shape index, L/D, 0.85), with pink flesh, colorless skin, very small style scars, and shallow stem-end depressions. The fruits are relatively free from hard core and cracks, and have excellent flavor. The most serious faults of this strain are low yields and susceptibility

TABLE I. Segregation of tomato plants with uniform-colored and green-shouldered fruits in F_2 progenies from crosses between uniform-colored lines of different origin.

Lines crossed	Observed number	Calculated number	$(O-C)^2/C$	χ^2
(1) Early 65-5 x U.G.*27				
Green shoulder	128	122.06	0.289	
Uniform color	89	94.94	0.371	
Totals	217	217.00		0.66
(2) Early 102-9 x U.G.25				
Green shoulder	111	110.81	0.0003	
Uniform color	86	86.19	0.0004	
Totals	197	197.00		0.001
(3) Progenies combined				
Green shoulder	239	232.87	0.161	
Uniform color	175	181.13	0.207	
Totals	414	414.00		0.37

* U.G. = abbreviation indicating Uniform Globe lines.

to tomato diseases. Some growers consider the leaves too large. Denver forcing-tomato growers use it because its high quality, "pink" fruits sell at a premium on the market.

Summary

A second gene for uniform unripe fruit color in the tomato is described. The symbols U_1/u_1 and U_2/u_2 are suggested to designate the previously described locus governing uniform color and this second locus, respectively. Crosses between lines homozygous for u_1 and lines homozygous for u_2 yield F_1 hybrids (U_1/u_1, U_2/u_2) with green-shouldered fruits. F_2 progenies segregate plants with green-shouldered fruits in the ratio 9:7, indicating that the two genes are on different chromosomes.

A forcing strain of Globe, homozygous for the genes u_2 and y (colorless skin) is described under the name Uniform Globe.

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THE ARMY NEEDS WAR DOGS

THE Army urgently needs more War Dogs and is appealing to patriotic citizens to donate their dogs to the Army to be trained for scout duty with the troops in the combat zones. The dogs' inherent ability to point game for the hunter is converted by military training and utilized to hunt the enemy, to detect snipers, ambushes, and otherwise unsuspected enemy presence, thereby saving countless human lives.

In order to meet current requirements, the Quartermaster Corps must obtain 1,600 dogs within the next three months. The needs are 600 in May, 400 in June, and the remainder in July.

The dog should be an easy keeper, in good health and condition. The working type dog is essential. Breed is of secondary importance to general excellence. Those breeds found most suitable for War Dog training are set forth below:

1. German Shepherd
2. Belgian Sheep Dog
3. Doperman Pinscher
4. Collie (Farm Type), with medium length coat
5. Schnauzer (Giant)
6. Positive crosses of above breeds

The Army's present need for dogs is vital. Dogs now being returned to their donors are mostly those that have served well on sentry and patrol duty in this country; these dogs are either not adaptable to training as scouts or not physically qualified for the rigors of overseas duty where they must share the hardships facing the combat soldiers; if the handler sleeps in the open in stormy weather, so does his dog, and if the handler has only "C" Rations, his dog must eat "C" Ration.

Quartermaster War Dog Liaison Representatives, patriotic citizens serving without pay, will make arrangements with dog owners for donations of dogs to the Army. Those accepted will be trained at Fort Robinson, Neb., by soldiers experienced and wise in combat scouting, after which they will be assigned to War Dog Platoons for duty.

Those who wish to donate dogs to the Army should write, or wire direct to THE AMERICAN GENETIC ASSOCIATION, 1507 M STREET, N. W., WASHINGON 5, D. C., for the name and address of the nearest local liaison representative of the Quartermaster General.

CROOKED NECK DWARF IN THE DOMESTIC FOWL

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Division of Poultry Husbandry, University of California, Davis

IN the spring of 1942, eggs were obtained from a pedigree breeder of New Hampshires. The progeny were raised and two males each mated to five hens were bred the following year. About eight months later the progeny of these two males and ten hens were mated and the eggs hatched. It was then discovered that a large number of the unhatched embryos had the same abnormalities, thus suggesting the presence of a lethal mutation in the stock. The progeny of both males used in the spring of 1943 and of several of the hens mated to them proved to be carriers which indicated that the mutation traced back to an earlier ancestor.

Description

The dwarf embryos (Figures 5 and 6) had a slightly short upper beak, a crooked neck which makes it appear short, and a reduced sternum with the keel and lateral processes of the sternum absent. The breast muscles are absent or much reduced. These abnormalities give the embryo, when the yolk is drawn into the body cavity, a full and rounded appearance (Figure 6). The legs look small and spindly, due mostly to a reduction in muscle and over-lying tissues, the bones being of about the same hardness and size or only slightly smaller than those of normal embryos. The 21-day-old dwarfs weighed much less than the normal embryos, apparently due mostly to the reduction in muscle but partly to the reduction in skeleton.

Most of the embryos were dead when examined on the 22nd day. They had apparently died on the 20th or 21st day, since the yolk was in most cases completely within the body cavity. The live embryos were rigid to the extent that they were unable to flex the hock (tibiotarsal) joint and there were no vigorous movements of the extremities typical of normal embryos. There was an abnormal amount of ammiotic fluid around the embryo, but the weight of the unabsorbed yolk was about the same as that of normal embryos.

The effect on hatchability is shown in Table I. It is similar to that of amaxilla[1] there being no apparent effect on early mortality but an increase in the percentage of dead in shell and a reduction in hatch. The effect shown by this mutation on the distribution of embryo mortality may be considered typical of mutants that can survive within the shell but are unable to hatch or are so seriously handicapped that few are able to get out of the shell.

Growth

In order to determine whether the dwarfs grew more slowly than the normal embryos from the beginning or stopped growing earlier, embryos were weighed daily from 10 to 20 days. Edema which was slight in some cases, extreme in others, was observed in 11- and 12-day-old and some of the 13-day-old dwarf embryos. Edema was not observed among younger embryos thus suggesting its occurrence in dwarf embryos for perhaps a varying length of time from the 11th to the 13th day of incubation.

The average weights of normal and dwarf embryos are shown in Figure 7. The average weights of the different age groups are based on from 3 to 11 dwarfs and on 3 to 26 normal embryos, a total of 64 dwarfs and 149 normals. The deviation from 3 normal to 1 dwarf is mostly due to the fact that when no dwarfs were found among the embryos from a particular hen the normal embryos were not weighed. Obviously, the embryos of different ages were not all from eggs of strictly comparable average weight, but the differences between dwarfs and

NORMAL AND DWARF EMBRYOS
Figure 5

Note slightly short upper beak and relatively slender legs of the dwarf on the left. The bending of the neck causes its apparent shortening.

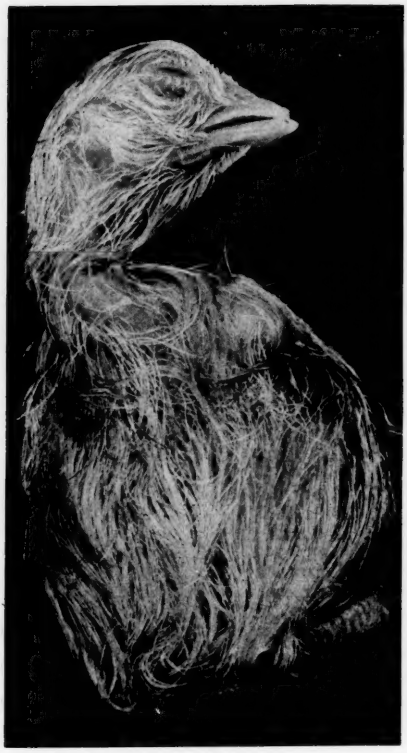
normals were reduced to a minimum by having some of each from eggs of the same hen. Finally, the age given is approximate. Nevertheless, the averages are considered to give a reasonably true comparison of the weights of the two phenotypes.

The main facts brought out by Figure 7 are: (1) the average weights of the normal and dwarf embryos differ little up to and including the 12th day, the dwarfs being smaller; (2) the dwarf embryos grew more slowly from the 13th to the 16th day; and (3) the dwarf embryos increased only slightly in weight after the 16th day—less in the four days from 16 to 20 days than the increase shown from the 15th to the 16th day, while in the same period the normal embryos more than doubled in weight.

Genetics

The dwarf embryos were originally observed in eggs from a flock of pullets mated to several males. It was therefore necessary to use only data for families (all chicks and embryos from any particular hen in the hatch) in which some dwarfs occurred. Such data from two hatches are grouped in Table II under segregating families. Later the pullets that had given some dwarf progeny were divided into three pens and mated to three males, one in each pen, and the eggs incubated. Two of the males proved to be heterozygous for the dwarf mutation. Data from the pens headed by these two males are summarized under known carriers. The more than 200 weighed embryos are not included.

The data in Table I are in good agree-



DWARF EMBRYO

Figure 6

The crooked neck and full bodied appearance is characteristic of the dwarfs. None of the dwarfs survived hatching.

ment with expectation on the basis of a ratio of 3 normal to 1 dwarf with no indication of sex linkage. It may therefore be concluded that the mutation is a simple autosomal recessive.

Discussion

A mutation producing comparable effects has apparently not been reported. Autosomal recessive dwarfism is known in the domestic fowl but the dwarfs[11] did not exhibit the anatomical abnormalities of the crooked neck dwarf and were able to hatch. Moreover, while the crooked neck dwarf reported in this paper has a short upper beak similar to the less extreme cases of short upper beak reported by Landauer[7] the two are otherwise so different that they must be regarded as distinct mutations. All of the other nineteen lethal mutations in the domestic fowl also obviously differ from the crooked neck dwarf.[8]

It is interesting to note that Dawson[2] found that the growth of his dwarf mice was practically suppressed after two weeks of postnatal life and skeletal differentiation was greatly retarded. Mutations are also known in the mouse which cause abnormalities in several parts of the skeleton[3, 9] (for a review of the cases see Gruneberg[5]) but reduction in the muscles comparable to that of the crooked neck dwarf has apparently not been observed in these, or for that matter, in any of the other numerous mutants in different species which exhibit skeletal abnormalities.

The effects of the crooked neck dwarf gene on the skeleton and muscles suggest that the gene may act independently on these tissues. If the effects on the muscles were indirect, the absence or reduction of the pectoral muscles being the result of the absence of the sternum then there should have been only slight reduction in the leg muscles whereas there is apparently a marked reduction. These findings do not, however, justify the conclusion that the gene acts in different ways to produce the effects observed.

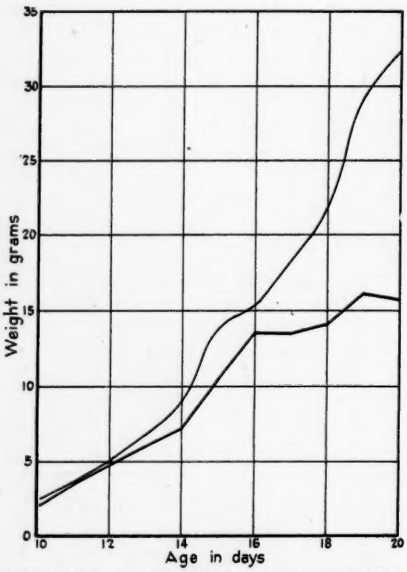
Most dwarfs are assumed to result from pituitary disfunction and in at least one case this has been proved to be true.[10] Some of the other causes of dwarfism have been reviewed by Landauer.[6] The present case may well be a pituitary dwarf. Whether that is so

Table I. Effect of crooked neck dwarf mutation on hatchability

Progeny	Fertile eggs	Dead Germs			
		1st week	2nd week	3rd week	Hatched
	No.	Per cent	Per cent	Per cent	Per cent
All normal	519	8.7	4.2	23.5	64.2
Normal and dwarf	202	5.9	4.0	37.6	52.5

Table II. Fg data. Number of normal and dwarf embryos.

Type of mating (see text)	Normal				Dwarf			
	♂♂	♀♀	?	Total	♂♂	♀♀	?	Total
Segregating Families	71	63	10	144	18	18	7	43
Known Carriers	32	36	85	153	10	13	37	60
Totals Obtained	103	99	95	297	28	31	44	103
Totals Expected				300				100



WEIGHTS OF NORMAL AND DWARF EMBRYOS

Figure 7

The weights differed very little before the twelfth day and growth of the dwarfs virtually ceased by the sixteenth day.

or not there is some indication that development is at first approximately normal but that some of the tissues later degenerate. There may be some similarity in this respect to the production of hereditary microphthalmia as reported by Gruenwald.[4] Further material is being collected to obtain information on this point.

Summary

An autosomal recessive lethal mutation in the New Hampshire breed of domestic fowl is reported which in the 21-day-old embryo causes a marked dwarfing of the embryo, a slight reduction in the upper beak, a crooked neck, absence or marked reduction in the sternum, pectoral and leg muscles and some reduction in the long bones. There is a noticeable edema for possibly varying lengths of time from about the 11th to 13th day and little increase in weight of the dwarf embryos after the 16th day of incubation. Twenty-day-old dwarf embryos are unable to make the vigorous movements characteristic of normal embryos and cannot pip the shell.

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Distribution of Rh Blood

Report on perhaps the first Public Health program in Rh blood testing by the Paterson, New Jersey, Board of Health:

"Nearly 3,000 blood specimens have been tested, the great majority of them antepartum. We soon found that there simply was not enough testing serum to include premarital specimens and but 616 of these were tested, of which 12 per cent were Rh negative.

"Approximately 15 per cent of the specimens received from antepartum sources were Rh negative. * * *

"We also request a specimen of blood from the husband of each Rh negative woman. The obstetrician secures this for us. Thus far each husband has been cooperative with the exception of 2, who could not see that they had anything to do with it! Of 98 husbands tested, 80 were Rh positive and 14 were Rh negative. The husbands of 4 Rh positive women were Rh negative. Prospects for an Rh negative woman to secure an Rh negative husband are not very brilliant, it would seem. No doubt many more Rh negative husbands would have been noted had all husbands of our antepartum patients been tested." — Saun and Brown, *J.A.M.A.*, May 5, 1945. P. 19.

"PIG JAW" IN COCKER SPANIELS

Retrognathia of the Mandible in the Cocker Spaniel and Its Relationship to Other Deformities of the Jaw

JAMES MCILVAINE PHILLIPS

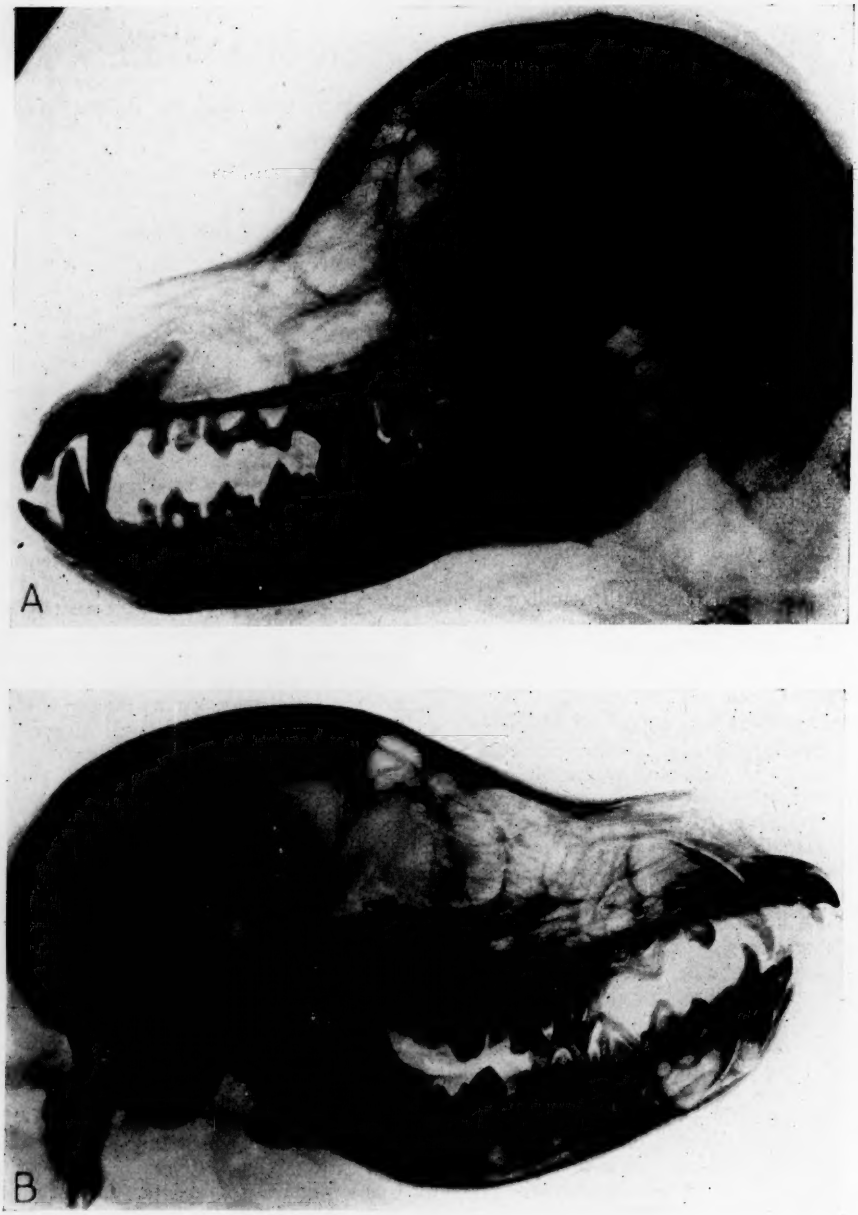
UNEVEN jaws are common in many breeds of dogs. In all breeds "pig jaw" (a mandible which does not extend as far as the maxilla) is severely penalized in the bench shows. In most breeds a lower jaw which extends beyond the maxilla (undershot) is an equal handicap, although in some breeds, notably bulldogs, this latter condition is a breed character and is not rated a defect. Undershot jaws are commoner in the short headed breeds such as Pekinese and Bostons. Pig jaw is most frequent in the long headed breeds like wolf hounds and collies. We occasionally find jaws with a unilateral deformity so that the bite is undershot on one side and pig jawed or normal on the other (wry mouth). All of these deformities are associated with poor teeth subject to early loss and decay.

Similar jaw abnormalities are reported in sheep,[7] and man,[9] where the evidence seems to indicate that they are hereditary. We have found no genetic study of malformed jaws in horses, though both parrot mouth and bulldog jaw occur.[4] In cattle agnathia is recessive.

All cocker puppies are born with very short faces. The most pronounced pig jaws may be detected at birth, but ordinary grades of this deformity only appear later in development. Most of the pig jaws can be diagnosed in ten-day-old puppies, and by eight weeks practically all of them can be culled. The permanently undershot jaw cannot be definitely detected until the second teeth are in. Many puppies with normal "scissors bite" at weaning time show undershot jaws when mature. We have also noted the development of a few dogs having definitely undershot jaws between weaning time and the eruption of the second teeth, which went on to mature as normals.

A Pig Jaw Strain

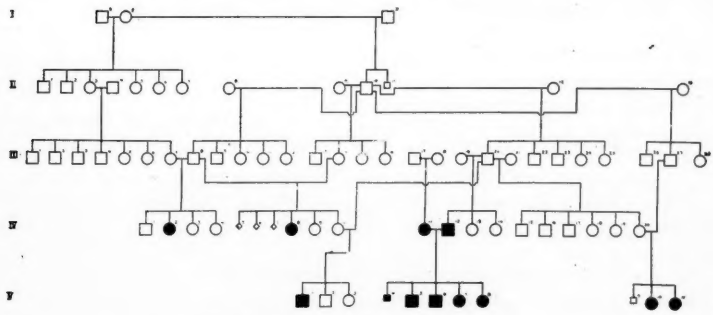
About six years ago one of our bitches with a slightly undershot jaw (III-14) whelped six puppies. One was stillborn, two very small pups lived but three days, two were apparently normal, and one (IV-8) developed a moderately severe pig jaw. Since at six months its lower jaw was only about three-fourths normal size the puppy was destroyed. Of the normal puppies, one was sold. Her sister (IV-10) was bred to a dog which sired puppies having the deformity when bred to other bitches. Three puppies resulted, one male (V-1) having extreme pig jaw and one male and one female apparently normal. The three puppies and their mother were destroyed as being unfit for breeding stock. After that, we had three other litters containing pig jawed puppies. Curious about possible genetic factors, we obtained a female (IV-11) severely afflicted with pig jaw, from another strain, and bred her to one of our dogs which showed a mild grade of pig jaw (IV-12). They produced four living puppies and one stillborn. At three months of age the four living pups showed a complete series beginning with a condition like the sire's and ending with a pup with a mandible about one-fourth the normal length. One litter of pups from closely related parents consisted of one stillborn male (V-9) and two undersized and extremely pig jawed females (V-10 and 11), one of which was totally deaf and the other very hard of hearing. Deafness had appeared in this strain before, unassociated with pig jaw. The litters containing pig jawed pups were usually smaller than the average cocker litter, and had a high percentage of stillborn and undersized puppies which lived but a few days. This strain produced far more undershot



JAW CONFORMATION OF MOTHER AND OFFSPRING

Figure 8

A—The mother, III-14, has a normal "undershot" lower jaw projecting slightly beyond the upper jaw. *B*—Her son, IV-8, has the undesirable "pig-jaw" in a fairly extreme form.



A PEDIGREE OF JAW DEFECT

Figure 9

This shows the outcropping of "pig jaws" in a strain of cocker spaniels. Apparently a recessive gene or genes are involved in the inheritance of this character which is considered a disqualifying defect by dog breeders.

puppies than pig jawed but we kept no record of their number.

Cockers may show an apparently normal occlusion between the incisors and canines but have molars set crosswise in the upper jaw as in the bulldog instead of the normal longitudinal placement. This is a result of maxillary shortening and these dogs have many progeny with bad mouths. Since ours is a commercial kennel where most of the youngsters are sold at weaning time it is impossible to trace them and thus we have been unable to study the undershot condition.

Factors Involved

The chart and history suggest that extreme pig jaw is a multiple factor recessive in cockers. Long haired dachshunds show a similar recessive character.[5] This breed originated from a cross between the spaniel and the short haired dachshund.[11] Stockard[12] showed the relationship of pig jaw to the various kinds of malocclusion and deformities which are found in the jaws of dogs. He crossed various long-headed breeds with short-headed ones. For short-headed dogs he used griffons, Boston terriers and Pekinese, selecting specimens with even jaws. He also used undershot English and French bulldogs. He believed that these short-headed breeds represented four distinct mutations originating in widely separated countries, and that each had its own specific developmental changes resulting from a complexity of genes, most of which were recessive. The F_1 progeny had jaws which were intermediate in length, most of them being undershot. The F_2 generation of all these crosses between long and short-headed breeds showed all grades of deformity ranging from extreme undershot to extreme pig jaw. He concluded that long maxillas and long mandibles were due to multiple factors and that those conditioning a long jaw were imperfectly dominant over short-jaw with the dominance better expressed in the lower than in the upper jaw. The genes determining length of maxilla and mandible often appeared to be inherited independently.

Removal of the thryoid glands from young sheep,[13] and dogs,[2] induced skeletal changes in the skull and long bones of the growing animal somewhat similar to the heritable achondroplasic changes seen in dogs.

Stockard's studies showed a wide variation in the structure and relative size of some of the endocrine glands of crooked legged and short skulled dogs in both his hybrid crosses, and in the original breeds used. These findings have lead to a rather widespread belief that the various skeletal differences found in specific breeds of dogs have

as their primary cause inherited variations in function of the thyroid, pituitary, and other endocrine structures. He states, "Disharmonies between the growth reactions of the two jaws in the same head make it seem evident that the quality of the endocrine environment cannot be altogether responsible for the inhibition of growth in one jaw and the stimulation of growth in the other. It would seem logical to expect that a modified internal chemistry would affect the simultaneous growth of two related structures in much the same manner." This is further supported by the fact that achondroplasic alterations of the body skeleton are found associated with achondroplasic changes in the skull in some breeds (bulldogs), in other breeds are found in connection with normal skulls (basset hounds), while still other breeds show these changes in the skull but not in the body skeleton (boxers). Interbreed crosses were reported by Stockard to show the transmission of the skeletal changes which he says are dominant, independently of the recessively inherited skull changes.

Stockard believed that jaw deformities in man have a genetic relationship similar to that seen in dogs, and have their origin in miscegenation of stocks with wide differences in the skeletal structures of the head.

Rubrecht studied the inheritance in man of both mandibular prognathism ("Hapsburg jaw") and micrognathia (or "bird face"). He charted each as a unit character but did not note any incidence of both defects in the same family histories. He believed that the separate factors upon which each of these conditions depended were irregular dominants. In man micrognathia is in some instances associated with cleft palate,[1,10] and may be a lethal.[6] In cattle agnathia is a lethal.[3]

The Brussels griffon has a very flat face, consequently the actual length of the jaws in proportion to the head size is about the least seen in any breed. When Stockard crossed this breed with the dachshund, in five F_2 hybrid litters only one litter of but three pups showed none deformed or dead. The abnormalities noted in the other litters were a tendency to amelia, absence of hair, other gross malformations, and dead pups.

Origin of Cockers

English breeders originated the cocker spaniel, using for their foundation stock very different types of spaniels.[8] Some of these were large dogs, some small, some had short crooked legs, others long straight ones. For many years in England cocker spaniels and field spaniels were registered from the same litters. If their mature weight was over twenty-five pounds they were classed as field spaniels. Dogs lighter than that were registered as cockers.

About 1900 I bred my first cockers. They were short legged, long bodied dogs with rather short muzzles and heavy heads. The fashionable cocker of today is a twenty-two to twenty-eight pound dog, short backed, well up on the leg, and has a head with a muzzle half its length. In England, starting with the same foundation stock, the breeders have evolved a dog a little larger than the American, and of much the same type except that it has a much longer muzzle and a less pronounced stop. When these two varieties are crossed, undershot and pig jaws are quite certain to appear in F_2. The strain of dogs which gave rise to my pig jawed specimens originated by crossing one of the old fashioned American type dogs with a long headed cocker of the English type which showed no English blood in his recorded pedigree, but was produced by a breeder who used English cockers in his kennel. We believe that the defects in the strain under discussion originated in the manner indicated by Stockard.

Conclusions

While the numbers involved are too small for definite conclusion it would seem probable that mandibular shortening in the cocker is inherited as a recessive with multiple modifying factors. Maximum shortening appears to be incompatible with life. Whether malocclusion and more marked deformities

result from shortening of the mandible depends upon the length of its associated maxilla, which appears to be determined by different, independently inherited genes.

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SOCIOLOGICAL JIVE

"But 'glory' doesn't mean 'a nice knock-down argument,'" Alice objected.

"When I use a word," Humpty-Dumpty said in a rather scornful tone, "It means just what I choose it to mean—neither more or less" . . . "The question is, which is to be master—that's all."

THE editors of the newly published "Dictionary of Sociology"* correctly point out that "every science must have its special vocabulary or terminology . . . the foregoing is perhaps even more true for sociology than for many other sciences." One's hopes are titillated when one notes that a distinguished editorial board and a panel of over 100 consulting editors have cooperated in this venture. The introduction is not clear, however, as to what basis was adopted for deciding whether a word is a sociological term, ordinary gutter or garden English, or "jive" (defined as "loose talk"). Hundreds of words are included that seem to be very much better defined in any standard dictionary. Thus "anonymity" is defined as "the state of being anonymous, disclosing no name, not known." That is what it means to everybody—in what respect is it "scientific" terminology? "Gossip" means to our editors "a face to face spreader of copious, superficial, often vulgar and untrustworthy news or tales; an idle tattler." Which again seems to add nothing to Webster. A definition of science which includes sociology and excludes mathematics borders on the fantastic.

There are many curiosities to fascinate the wordsmith, such as berdache, allrightnick, osay. Surely these will add to the amenities of conversation ("amenities" are "decorative structures, open spaces, parks, playgrounds, plantings and all other natural or artificial characteristics of an area which add to its pleasantness or attractiveness as a place to live, or which protect it against unpleasant sights, noises or other nuisances").

In the discussion on what is in and out of sociology occurs this statement: "Thus 'amulet' is definitely an anthropological term and yet it has genuine sociological significance. On the other hand 'blowgun' is a little too specialized to belong in a dictionary of sociology." "Kilocycle" is not included, and with half a dozen radio networks it must almost approach "amulet" in sociological significance. In case "kilocycle" is considered "too specialized," what about "basing-point," "horsepower," and "T. V. A.," all of which have enormous so-

*Dictionary of Sociology. Henry Pratt Fairchild, Editor. Pp. 6+ 342. Philosophical Library, New York, 1945.

ciological significance? The reader may also be cast into perplexing Freudian speculation when he notes that "coitus" is included but "orgasm" is not, a lacuna which seems somehow to epitomize this lexicon.

In the field of genetics, the fare is unfortunately very mixed. If a special dictionary of this kind has any meaning, it is in its exact definition of technical terms and in clarification of peripheral terms carried over from other disciplines. Few geneticists would want to quarrel with the definition of "Mendelian ratio" which begins as follows: "the ratio of chance combinations of the genes, or hereditary factors, in the offspring of crossbred plants and animals. Such ratios may be either genotypic, i. e., carried in the germ plasm, or phenotypic, i. e. manifested in the somatoplasm . . ." If we wish to develop our ideas further concerning the two terms "genotypic" and "phenotypic" we get the following: "genotype. The category which accounts for the underlying nature and causes of things," and "phenotype. A descriptive category which accounts for external appearance." Evidently these definitions were compiled by a lexicographer better grounded in Greek than in biology, for neither gives any concept of the exact and crucial distinction between genotype and phenotype, which is clearly set forth in Webster. In any discussion of the interaction of genetic and environmental factors in the expression of human behavior, clarity regarding this point is very essential.

"Inbreeding" is defined as "the process by which a group of institutions tend to become static or retrogressive for lack of the introduction of new biological or psychological elements, or new personalities." Sociological discussions must sometimes have reference to the biological meaning of the term, namely the fixing of a type by mating of closely related organisms. To apply the above definition to discussions of biological inbreeding would only compound the confusion. "Ontogenetic" means "having to do with the origin and preservation of the individual, Cf. self maintenance," and "self maintenance" means "mores which promote or are believed to promote societal survival within given life conditions. Institutional forms; industrial, military, governmental, religious organizations adjusted to the physical, social, and supernatural environment." Surely the biological concept of "ontogeny" as defined by Webster, "the life history or development of an individual organism;—distinguished from phylogeny or evolution of a race or group" is altogether preferable. Inheritance is defined purely forensically (a word used in the dictionary without definition) as "the rule governing the transmission of property, being 'patrilineal,'" etc. There is not a whisper about biological inheritance. We are perhaps justified in reading with raised eyebrows the statement in the introduction that "the dictionary stands as a unique representation of the precise thinking of the sociological fraternity as a whole."

The last word, "zygote," closes the discussion on a high biological plane that neither Webster nor geneticists would quarrel with. But a sprinkling of excellent definitions cannot make up for the wordiness, looseness, and pedantry of many others.

To close on a more cheerful note, the reader is asked to give himself three guesses as to what this is:

"The most essential, relatively stable central institution of face-to-face human relations, generally in an accustomed place, with dwelling house, equipment and surroundings presumably adapted to the needs of the family in it. It is naturally and usually the place with the refreshing and encouraging social atmosphere, cooperative management and daily cultivation of the more intimate human interests and values: those of conjugal love, sex relations, birth and rearing of children, mutual human recognition and appreciation, economic sustenance, refuge from social perplexities and dangers, sleep, rest, health care, recreation, morale building, and general training in the social courtesies and amenities approved by the community."

That, folks, believe it or not, is where we hang our hats. Palace or hovel, amenities and all, it is "home" in the lexicon of sociology. God bless it and us.—ROBERT COOK.

TIMING AND PRODUCTION OF GRAPE POLLEN BY GRAFTING

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IN plant breeding the availability of the proper pollen at exactly the time required is of paramount importance. Often the normal flowering period of a staminate parent may be months too early or too late to pollinate the proposed seed parent. Breeders of many plants are fortunate in that pollen can be preserved in viable condition for considerable time, if properly dried and stored in a cool and dark location. With other genera, the grape for example, pollen retains its potency even under the best conditions for a very short time. Hence one of the greatest problems of the plant breeder is to assure a supply of fresh, viable pollen on the date that the seed-parent is in flower.

The grape breeder sometimes finds this problem especially acute. When working under environments that are alien to most cultivated varieties, as for instance in the humid tropics, the procurement of the necessary pollen is often a major difficulty. In many instances it is found practically impossible to grow to flowering size certain varieties of North American and European grapes most desirable for breeding. Also, the prolonged dormancy resulting from insufficient chill in the warmer climates often retards the flowering of most varieties of the *labrusca* and *vinifera* species until a date much too late to be of value. In all events, the control of pollen production with regard to the required date and varieties must be mastered before any real degree of success can reward the breeder's efforts.

A relatively simple technique has been developed which when properly carried out has proven to be a major factor in solving the problem of pollen control in grape breeding. This method, though based primarily upon the simple process of grafting, does require, nevertheless, considerable practice and a knowledge of varietal differences before good results are assured. Accordingly, best results should not be expected until after a few seasons practice.

Materials and Methods

The timing of pollen production by the graft method depends, primarily, upon a careful timing of certain procedures. Considerable accurate data relative to the growth and flowering habits of both proposed parent vines are a prerequisite to satisfactory results. First, we must know the approximate flowering date of the intended seed parent. Second, we must know the time interval which intervenes between first growth, or budding-out, and flowering of the prospective pollen parent. There is often considerable varietal variation in the length of this interval. The time required from date of grafting until growth begins is about the same for all varieties studied, under proper conditions. Generally speaking, this latter period will be about four weeks if the precautions here listed are taken.

Selection of Varieties

The careful selection of stock vines, especially in regard to whether they are early, medium or late in budding-out, is of considerable importance. If successful grafts are to be assured, the date at which the stock naturally starts to grow should coincide with or somewhat precede that of the scion. Growth date of the scion is determined by date of grafting. Most species or varieties of the *Euvitis,* or bunch grapes can be used successfully as graft stocks, although those kinds that root well from cuttings generally give the best results.

As an example let us take as our proposed seed parent the wild *Vitis shuttleworthii,* which in Southern Florida usually begins flowering about March 20. We wish to cross this early species with pollen of the cultivated variety Marguerite, which normally blossoms much too late to be of use in pollinating our chosen pistillate vine. Previously we have obtained dependable data relative to time interval elapsing between budding-out and flowering of our proposed pollen vine. This period let us say is 35 days. We then count back 35 days from March 20, the blossoming date of our seed parent and arrive at the date of February 13. From this latter date we then subtract the time required between grafting and initial growth, or budding-out, known to be approximately 25 days. This gives us the basic grafting date: January 19 or 20. Since unforeseen factors may somewhat modify these growth and flowering periods it is a good precaution to make three sets of grafts with one six days ahead of our basic date and one six days after it.

Preparations Prior to Grafting

Certain important preliminaries should be carefully attended to before arrival of the designated grafting dates. Since vine pruning is usually done in January, scion material of chosen pollen varieties should be obtained slightly prior to this time. The scions should be taken from dormant, well ripened, one-year wood from a quarter to a half inch in diameter, depending on variety. Each scion should have from three to five well developed dormant buds and is best taken from between the fourth and twelfth leaf nodes. Grape scions can easily be held for two months or more without serious deterioration if they are carefully covered with slightly moist sphagnum moss or sand, wrapped in waxed paper and stored in a temperature of about 40° Fahrenheit.

Grape scion material, whether from the cold north or from the Tropics, that has been subjected to its natural environmental conditions until removed from the vine and treated as described until grafted will show little or no dormancy influence affecting the date of initial growth. If thus handled, all varieties will have received sufficient chill or other growth stimulus for their individual needs and will be ready to begin luxuriant growth as soon as other conditions are favorable. In warm climates the real problem is to prevent this growth action until the graft union is sufficiently developed to support it.

In warm regions it is important to select the vines to be used as stock for grafts several weeks in advance and to do all necessary pruning or cutting at that time. If this expedient is carefully observed there should be little or no "bleeding" induced by the grafting process, provided that only straight, with-the-grain splits are made in the stock. Otherwise an unexpected rain just before or soon after grafting may induce prolonged "bleeding" from the fresh wounds at the graft union and may endanger the success of the experiment.

In warm climates the bleeding of the stock causes two difficulties. It affords the moisture which the scion, already passed its dormant period, utilizes to force its buds prematurely into growth. It also encourages the development or various harmful cryptogramic organisms in and near the spliced areas which may prevent a successful graft union.

In the selection of stock vines to support scions of the pollen varieties, only those should be used whose normal growth dates approximate or preferably slightly precede the desired budding date of the particular scion variety. Grafts may be placed high on the stock vine and a single plant may be made to support numerous scions, depending, of course, on the size of the stock and the number of branches of the proper size.

Grafting Process

The actual grafting employed in this work follows the well known cleft-graft method. Considerable care is advisable to make sure that straight, with-the-grain splits are made and that the cambiums of both stock and scion make

good contact. No wax nor covering of any kind should be used. Grafts should be securely tied, but care must be taken that the tying material does not in any way cover up the spliced areas. Air and thorough drainage are necessary for the knitting together and growth of the cambiums.

Care of Grafts

After all grafts are in place and securely tied the stock vine may be bent over to the ground and the grafts arranged so as to lie as nearly flat as possible. The scions should be thoroughly covered with several inches of slightly moist soil and it is imperative to make certain that actual regions of the grafts are well covered. A burlap bag, split open and spread immediately over the grafts and under the soil covering, will often allow a more ready inspection from time to time. It is also important that the soil around and under the grafts be well drained, yet it should never completely dry out. If the soil covering should become too dry it may be very slightly moistened.

It is well to place as a final covering over the entire soil mound a sheet of tar paper or other waterproof material which will serve as a protection against rain. If this precaution is neglected an unexpected shower may saturate the soil around the scions and prematurely force out all flowering buds. These will soon wither and leave only secondary buds, mostly non-flowering, for later growth. Normal growth of properly inserted and cared for scions will usually begin in about four weeks after grafting.

As soon as true growth begins, as indicated by the healthy swelling of the dormant buds, the vine may be raised to the trellis and securely tied. For at least a month after the vine is attached to the trellis, care should be taken to prevent strong winds from breaking the graft union. As soon as the scion becomes flushed with vigorous growth the strain on the newly formed union may prove too great unless both scion and stock are securely supported.

Discussion

There is no wish to leave the impression that this method of pollen control is infallible. Results depend in a large measure on the care and skill with which the work is performed, and upon proper choice of the material and timing. Over a period of several years between 40 and 80 per cent of the writer's grafts have come through to produce pollen at the time desired. Success has been dependent on weather conditions, stock vines employed and other influences. A careful consideration of the possible speed-ups or delays that may result from abnormal weather conditions is often quite important.

The graft method of pollen production has proven an invaluable aid in the author's grape breeding efforts in tropical and sub-tropical climates. It has rendered easily possible the crossing of any desired combination of bunch grape, irrespective of the great divergence in normal flowering periods or of their inability through alien climatic influences to reach the flowering stage in the normal way. Properly handled grafts will produce vigorous shoots and the pollen produced is quite comparable in quantity and viability to that produced naturally. If stock vines are given reasonable care they may be employed year after year.

It is well understood, of course, that only those flowers which are of the same season as the grafting, or more specifically, only those which develop from dormant floriferous buds on the previously chilled scions, are controlled by the grafting date.

The extent to which this method might be successfully applied to other plants has not been tested.

Summary

The control of pollen production in grapes by timed grafts of the desired pollen variety is described. By this means pollen can also be obtained from kinds which, due to alien climatic conditions, cannot be brought to flowering in the normal way. The writer's experience with the method has been most favorable, making possible crosses that could not have been achieved by other means.

PARENT BREEDS AND HYBRIDS

Figure 10

A—Poland China boar 175. *B*—Poland China sow 356. *C*—Litter out of sow 356 by boar 175 showing typical black body color with white feet, a white splash on the face and white on the tip of the tail with an occasional splash of white on other parts of the body. *D*—Landrace boar 4.1. *E*—Landrace sow 1176. *F*—Litter out of now 1176 by boar 4.1, showing solid white body color. *G*—F_2 sow 207. This sow shows about the average amount of black on black spotted F_2 animals. Her body color was white. *H*—"Topcross" litter out of sow 207 by boar 4.1. All of the pigs in this litter were solid white, indistinguishable in color from pure Landrace pigs.

INHERITANCE OF COAT COLOR IN SWINE

II. Results of Landrace by Poland China Crosses*

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IN the first paper of this series‡ the major color variations in swine were described and an attempt was made to give an account of their mode of inheritance. The present paper is concerned with an analysis of the genetic differences between the Danish Landrace and the Poland China patterns.

The Landrace animals used by us trace to a group of eight boars and sixteen sows imported by the Department of Agriculture from Denmark in 1934. All of them, and some 2,000 descendants produced by the U. S. Bureau of Animal Industry, have been self white. Occasionally, however, some of the young were described as possessing black skin spots. Usually the spots were present at birth but a few animals showed no spots until they were several weeks old. No attempt will be made here to explain the incidence of skin spotting, except to suggest that it probably is determined by minor density factors. (See Figure 10).

All the Poland Chinas used in the experiment were descended from registered stock purchased at different intervals. Their color was typical of the breed, being black except for the six white points on the feet, the face, and the tip of the tail. (See Figure 10.)

The Hybrids

Five Poland China boars were mated with 15 Landrace sows. The 146 F_1 pigs were all white. Showing that the white of the Landrace is dominant over the black of the Poland China. However, as in the case of the white pigs produced in subsequent generations there was a larger proportion of blue spotted pigs than is common for the Landrace. The spots tended to be larger and were more widely distributed, being especially numerous on the back, shoulders and thighs.

Five of the 19 F_1 sows which were selected for breeding purposes produced 157 F_2 pigs by two F_1 boars, while 17 the F_1 sows produced a total of 230 backcross pigs by four Poland China boars. When classified according to the presence or absence of black, the F_2 gave a total of 126 white and 31 black, while the backcross to Poland China gave a total of 114 white and 116 black. A glance at the results in Table I shows that in both cases there is good agreement with expectations on a one-factor basis. Thus there can be no reasonable doubt that in this cross the absence of black is due primarily to a single dominant factor possessed by the Landrace.

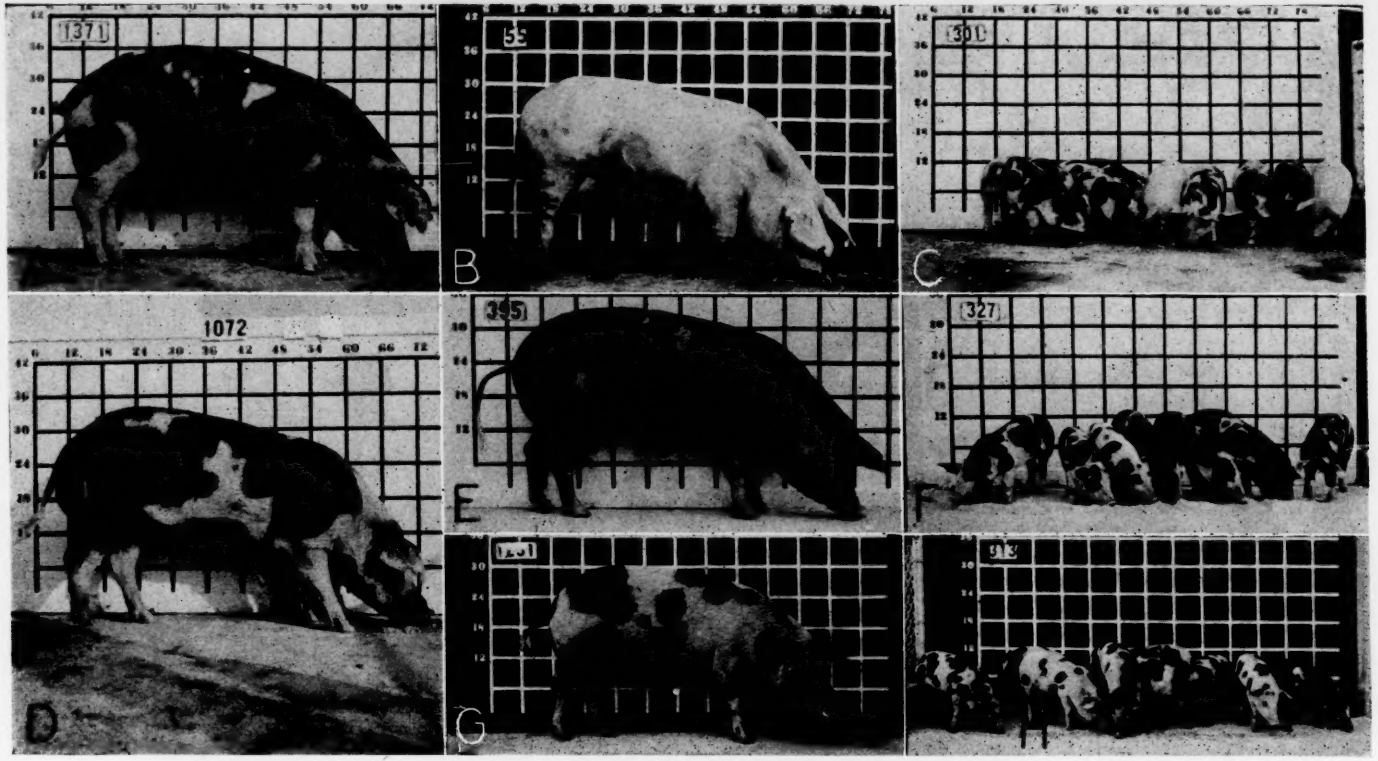
Results in Later Generations

In accordance with the general plan of the experiment, as previously described, a total of 2,079 pigs was produced in addition to the F_1, F_2, and backcross generations. Of these 2,079 pigs, 515 were produced by crossing black spotted segregates of the F_2 and backcross generations (as well as of later segregating generations) back to Landrace (topcross pigs); 476 were produced by intercrossing topcross animals (F_2-equivalent pigs); 428 were produced by backcrossing black spotted segregates to topcross animals (backcross-equivalent pigs); and 660 were produced by intercrossing black spotted

*Data obtained at the Beltsville Research Center, Beltsville, Md.

†The author acknowledges his indebtedness to Mr. J. X. King for recording the colors of the pigs used in this study.

‡HETZER, H. O. *Jour. Hered.* 36:121-128. 1945.



TYPES IN LATER GENERATIONS

Figure 11

A—F_2 boar 1371. This boar shows about as much black as was observed among F_2 animals. *B* shows a white sow out of Landrace sow by a black spotted boar selected from backcrosses of F_1 to Poland China. She was thus heterozygous for the inhibiting gene *I*. When mated to boar 1371 she produced 11 pigs, of which 2 were white and 9 white-and-black. Those alive at weaning time are shown in *C*. Boar 1072, sow 395 and sow 1231, shown in *D*, *E* and *G* respectively, are F_2-equivalent animals illustrating the variation in the amounts of black among black spotted segregates. Sows 395 and 1231 are full sisters. While both of them produced only black spotted pigs when mated with boar 1072, it will be seen that the pigs in *F* which were out of sow 395 showed larger amounts of black, on the average, than those in *H* which were out of sow 1231. The difference between the two groups of pigs is in the same direction as that between their dams, thereby showing that modifying factors were at least partly responsible for the variations in the extent of black spotting.

segregates. If the above interpretation is correct, the topcross pigs should be all white, the F_2-equivalent pigs should give 3 white: 1 black, the backcross-equivalent pigs should give 1 white: 1 black and the descendants of black × black should all be black. A summary of the four groups of progenies is shown in the lower part of Table 1. In each case the numbers are those referred to above, except for the omission of the offspring of one Landrace boar (95 topcross pigs) and those of one of his daughters (64 F_2-equivalent pigs). Omitting these pigs from consideration is done for convenience, for as will be seen later, the breeding record of these two animals is not incompatible with the conclusions indicated by the remainder of the data.

The results of the first three crosses referred to above are very similar to those obtained in the F_1, F_2 and backcross generations. Furthermore the absence of any but black pigs among the 660 descendants of black × black, proves definitely that the black possessed by the Poland China depends on one major gene which is recessive to the white of Landrace. Incidentally it might be noted that reciprocal crosses were made in the production of both the topcross and the backcross-equivalent generations, but in no case did they show any significant differences. Separation by sex likewise gave no significant differences. Hence we can conclude that the principal color gene is situated on an autosome.

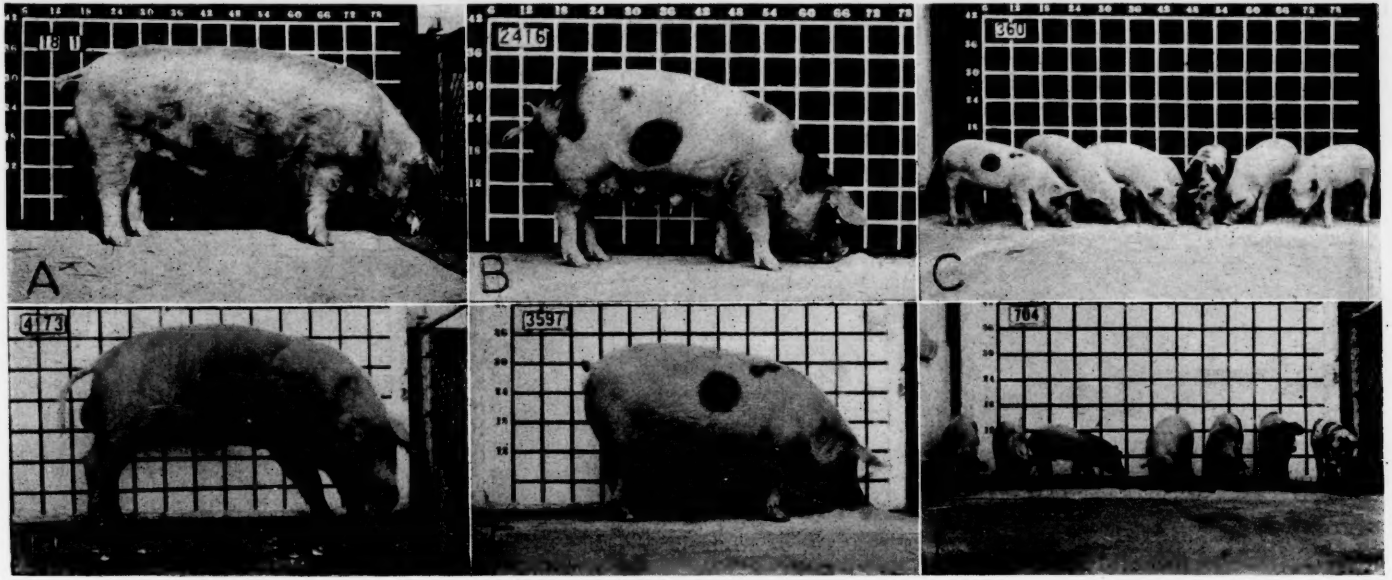
Physiological Effects

Nothing in these data gives a clue as to whether the gene conditioning white in the Landrace is a dominant allele of the gene for black possessed by the Poland China or whether their relation is an epistatic one, involving two different loci. However, the results of others, as well as other data obtained by the writer (to be reported in later papers) leave no doubt that the latter hypothesis is correct. Hence we may conclude that the Landrace probably has the same factor for partial extension of black as is possessed by the Poland China, and a separate dominant factor which is able to inhibit black color. Thus if the factor for white is designated by *I*, that for its absence by *i*, and the factor for partial extension by *Ep*, the genetic formulae for the two breeds might be represented by *Ep Ep II* for the Landrace and *Ep Ep i i* for the Poland China.

Peculiar Results

The point of special interest in regard to the data excluded from Table I is that two of the 95 offspring produced by one of the Landrace boars used in producing the topcross pigs were described as black spotted, when according to theory all should have been white. These pigs, a male and a female, were out of a litter of seven whose dam, a black spotted sow, had a total of 17 pigs, all by the same Landrace boar. The fact that this boar had only white pigs, 78 in all, when mated to seven other sows carrying black clearly rules out the possibility that he was heterozygous (*Ii*). If that had been true, about one-half of his 95 offspring should have shown black. Errors in recording or identification of pigs by the men actually in charge of the work might account for the two exceptional pigs. The writer has not accepted this explanation because extreme care was taken throughout to guard against any errors during both the breeding and farrowing seasons. (See Figure 12.)

The only other likely possibilities are that the two pigs in question had an excessively large number of modifiers, thereby causing them to show black, or that they represent a recessive mutation of *I* to *i* which occurred in their sire sometime during early spermatogenesis. If the first hypothesis be correct, and if there be segregation of some of the modifiers the two exceptional individuals when mated with black spotted animals would be expected to have some self white offspring. If the second hypothesis be correct, only black spotted pigs should be produced by the exceptional animals when similarly tested. Unfortunately no such tests were made. How-



BLACK SPOTTED PIGS FROM A LANDRACE BOAR

Figure 12

A—Landrace boar 18.1. As noted in the text this boar when mated with 7 black spotted sows sired only white pigs, 78 in all. When mated with another black spotted sow (2416, shown in *B*) he produced 15 white and 2 black spotted young. The litter containing the black spotted pigs is shown in *C*. Obviously boar 18.1 was not heterozygous, for if that had been the case, about one-half of his offspring should have been black spotted. While no attempt was made to determine the mechanism responsible for the two exceptional pigs, one of them (sow 3597, shown at the left of *C* and in *E*) produced 39 white and 25 black spotted pigs in matings with two white boars heterozygous for *I*. The fact that this is a fairly satisfactory 1:1 ratio practically rules out the hypothesis that minor factors for extension of black were responsible for the two exceptional pigs, yet it does not afford definite proof that the two pigs in question arose as the result of a mutation of *I* into *i*. One of the heterozygous boars which were mated with sow 3597 is shown in *D* while one of the two litters from this mating is shown in *F*. Note that the 6 black spotted pigs in *F* closely resembled their dam as regards amounts of black present.

ever, it is worth noting that one of the exceptional pigs, a female, when mated with two white boars that had previously been proven to be heterozygous for *I* produced 14 white and 11 black spotted pigs with one of the boars and 25 white and 14 black spotted pigs with the other. The fact that the numbers are fair approximations to 1:1 ratios practically rules out the first hypothesis. Nevertheless, additional data would seem necessary to substantiate the theory that a mutation was responsible for the two exceptional pigs.

Distribution of Black

Another point of considerable interest regarding the results of this cross is that the pigs described as black in the aforegoing discussion showed a great deal of variation in the amount of black present. A few pigs had as much black as the Poland China, but the great majority showed considerably less black than typical of that breed. The distribution was a graded series covering almost the entire range from solid black with the usual white markings through the Spotted Poland China patterns to patterns exhibiting only one or two spots of black. Even among littermates there were some rather marked differences, although littermates tended to show less variation, on the whole, than non-litter mates. (Figure 11.) These results are very similar to those reported by other workers in crosses involving the Poland China or Berkshire. They clearly support the conclusion that the Poland China has, in addition to a single factor for black spotting or partial extension, several factors favoring the extension of black. Such factors appear to be lacking in the Landrace which obviously supplies factors which tend to restrict black.

Finally, it might be noted that all of the pigs showing black had a white background except one in F_2, three in the backcross, 12 in the backcross-equivalent generation and 12 among the descendants of black spotted by black spotted. Some of these pigs had broken splotches of red and white hairs in combination with black. In others the white hairs had a distinct reddish tinge. While the numbers are too small to permit an analysis of this condition, the results are compatible with the conclusion indicated by the results of other crosses to be described later, that red is due to the concurrence of two or three partially recessive intensity factors, some of which in this case may have come from both the Landrace and the Poland China.

Table I. Number of white and black pigs in the F_2 and backcross generations of the Landrace X Poland China cross. Included are the results of various other crosses of the same original cross.

Name of crosses	Number of Pigs		χ^2	P
	White	Black		
F_2 generation				
F_1 - white x F_1-white	126	31		
Expected (3:1)	117.8	39.2	2.31	0.14
Backcross generation				
Poland China x F_1 - white	114	116		
Expected (1:1)	115	115	0.02	0.90
Topcross generation				
Landrace x black	420	-		
Expected (all white)	420	-	-	-
F_2 - equivalent generation				
(L x Black)-white x (L x black)-white	310	102		
Expected (3:1)	309	103	0.01	0.91
Backcross-equivalent generation				
(L x Black)-white x black	216	212		
Expected (1:1)	214	214	0.04	0.86
Black x black	-	660		
Expected (all black)	-	660	-	-

Summary

Five Poland China boars were crossed with 15 Landrace sows. All of the 146 F_1 pigs thus produced were self white except that many had varying numbers of black skin spots. There was no indication of genetic differences between the white-skinned and the spotted pigs apart from those due to differences in minor factors.

A total of 157 pigs was produced in the F_2 generation, while backcrosses of F_1 females to Poland China males gave a total of 230 young. In both generations the ratios of white to black agreed closely with those expected on a single factor hypothesis. The whites again included some with spots of black in the skin, while the blacks were more or less spotted. Most of the latter had a white ground color but there were some which showed red roan in addition to white.

Other crosses, involving a total of 2,079 pigs, gave results in close harmony with the hypothesis that one major gene conditions black or white pigmentation,

modified by minor genes for restriction and extension of black.

For reasons to be discussed more fully in a later paper, the inheritance of the Landrace self white is explained on the basis of a dominant epistatic gene which operates as an inhibitor rather than on the assumption of an allele of the gene for black. This indicates that the Landrace and Poland China are genetically different in regard to a fundamental gene which affects the production of color, while they probably both carry the same fundamental gene for black. Thus the formulae which must be assigned to the two breeds are *Ep Ep I I* for the Landrace and *Ep Ep i i* for the Poland China, where *Ep* is the symbol for partial extension of black, and *I* and *i* are the symbols for white and color respectively.

✦

Note on M. Zlotnikoff's "A Human Mosaic"

THE simplest explanation of this human bilateral mosaic is that a dominant mutation with pleiotropic effects occurred in the left-hand member of the first pair of blastomeres. Somatic segregation, non-disjunction, or deletion, in the case of a heterozygous recessive gene for the condition, would also be possible alternative causes, not to speak of more complicated mechanisms. Sectorial mosaics, and in particular those that are divided strictly bilaterally along the mid-sagittal plane, are seemingly very rare among mammals. Those that have been reported are almost exclusively sex mosaics (true lateral hermaphrodites). Those that can be regarded as possibly gynandromorphs have been described in the pig (once),[14] the mouse (three times, one being doubtful),[2,3,5] field mouse (once),[1] rat, (once),[7] guinea pig (once),[11] and man (once).[12] In addition, there are some human cases of hemiplasia (see Mohr),[13] in many of which the skin of the hypertrophic side shows a tendency to form pigmented naevi, somewhat like the skin of the left side of the present individual. The rarity of such mosaics in mammals, and in other vertebrates also, has often been thought to signify that vertebrate development is so influenced by diffusible and circulating substances that genetic autonomy is virtually absent. The fact that true gynandromorph birds[10] and mammals do arise indicates the weakness of this view, and the sectorial mosaics (birds,[10] guinea pigs,[15] mice[8]), including this human case, offer even clearer evidence. A second interesting feature of the present case is its strict limitation to one side of the midline. This affords a graphic indication that in man the two sides of the body, at least in some instances, are derived respectively from the first two blastomeres. In salamanders,[4] both bilateral and more irregular chromosome mosaics occur. In guinea pig[15] and mouse,[6] strict bilaterality has not been described. Another case of a strictly bilateral mosaic in man was pictured in the newspapers some years ago, but has seemingly not been further investigated.[6] A third interesting feature of the present case is the pattern of the markings, a pattern which strikingly suggests the dermatomes of the neurologists, especially those worked out by Head[9] on the basis of herpetic eruptions. It is certainly to be hoped that further study of this most interesting human mosaic will be made, particularly in the event of any offspring.

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